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INDUSTRIAL RESEARCH & DEVELOPMENT

MARCH 1980

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Colorimetry with a spectrophotometer

Who earns what in R&D?

Where we're going in energy research

(Economical) interactive image analysis

Here's what's new in metallurgical coatings

plus: Our unique news section for people in R&D

INDUSTRIAL RESEARCH & DEVELOPMENT

SERVING THE $107-BILLION WORLD-WIDE R&D INDUSTRY

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C1 **Chromatography:** 32,000 copies contain this section following p. 164.

approx. 3,000 copies to nonqualified readers contain pp. 2A and 2B.

ABOUT THE COVER

In the 0/45-deg spectrophotometer, the continuous interface wedge filter, hermetically sealed in glass, allows continuous scanning of the spectrum within the range of 380 to 710 nm. The band pass is approximately 2.5% of the center wavelength. For example, at 400 nm, the total band pass is 10 nm. An article about spectrophotometric color determination begins on p. 126 in this issue.

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Technical Publishing

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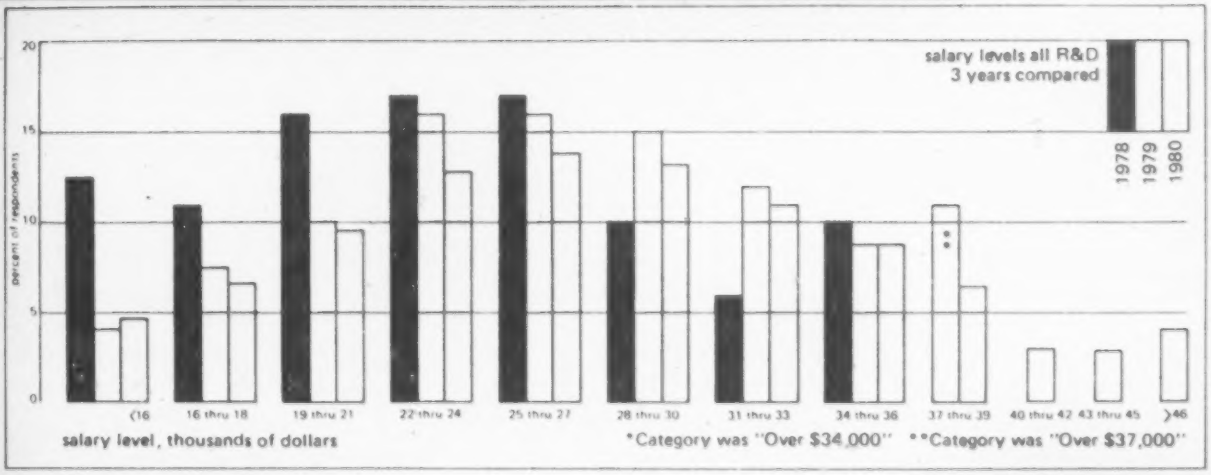
ABP BPA

Robert R. Jones
Editor

Bigger pay checks, less buying power for people in R&D



Clear evidence that salaries are going up in R&D can be seen on this chart. We have added three new salary ranges at the top and still end up with a bulge in the highest category where it should taper off.

Readers continue to report steadily increasing salaries, but rate of increase appears to have slowed and many people in R&D find their gains have been mostly on paper.

SALARIES ARE UP in research, development, and quality assurance—they definitely are up. There is a 29.5% increase in the number of persons earning more than $37,000 per year, and there are declines in the percentages of persons reporting lower salary ranges.

Enthusiasm must be tempered, however, by the very-strong likelihood, if not actual certainty, that average salaries in research, development, and quality assurance have not kept pace with inflation.

These conclusions are drawn from our annual survey of readers which this year produced usable responses from 5,158 scientists and engineers.

The accompanying chart, "Salary levels all R&D," illustrates the distribution of scientists and engineers in 12 salary ranges over the three past years. Perhaps as notable as any other information portrayed on the chart is the fact that highest range in 1978 was "Over $34,000." For 1980's report, we have extended the ranges to "more than $46,000," and this new upper level now contains almost half as many respondents as the "Over $34,000" did just two years ago.

In 1978 we reported that "many of these gains are more apparent than real." This year, such a statement can be repeated. Unlike last year when median income for all respondents had increased nearly 13% from the 1978 figure and more than covered inflation, this year's median salary for all respondents, at $28,476, is only 3.5% higher than last year's.

In the battle against inflation, it is noteworthy that 37.2% of this year's respondents are earning more than $31,000 annually, up from 32% last year and a mere 13% in 1978. It does appear, however, that the salary range for persons working in research, development, and quality assurance has been stretched out. While the crowd at the top has gotten larger, the

number at the low end is no smaller. In 1979, 4% were earning less than $16,000 per year, and the number is even a bit larger than that this year. Back in 1978, though, there were three times as many in that salary range.

More than half of the 5,000-plus respondents received a salary increase of 6% through 9% during the past year. This is higher than the number getting such raises in our 1979 report, but so is the inflation figure larger than for 1979's.

Some 8.8% received raises of 14% or more in the past year; only 6% of the last year's respondents exceeded 14%.

Increases were not evenly distributed throughout the professions. Details for six different parameters by professions are shown in the charts. The differences by profession have caused some shifting in the rankings. Information received in this most-recent survey leads to the following rankings by median salary:

Rank	Profession	No. responding	Median salary
1	Mathematician	37	$33,099
2	Aero. Engr.	73	32,226
3	Physicist	458	$31,050
4	Metallurgist	227	30,228
5	Elec. Engr.	555	29,635
6	Mech. Engr.	500	29,480
7	Chem. Engr.	404	29,272
8	Chemist	1,875	27,031
9	Indust. Engr.	57	26,649
10	Other	629	26,118
11	Biologist	226	25,561

Biologists, last on the above list, clearly lead the ranks in the area of advanced degrees. Fifty-four percent of the biologists have PhDs compared to only 8.8% for the industrial engineers. For all respondents, 28.2% have a PhD, 25.7% master's, 38.2% bachelor's, and 7.9% less than bachelor's. Salary for education for all respondents for this year and two previous years is shown in a chart.

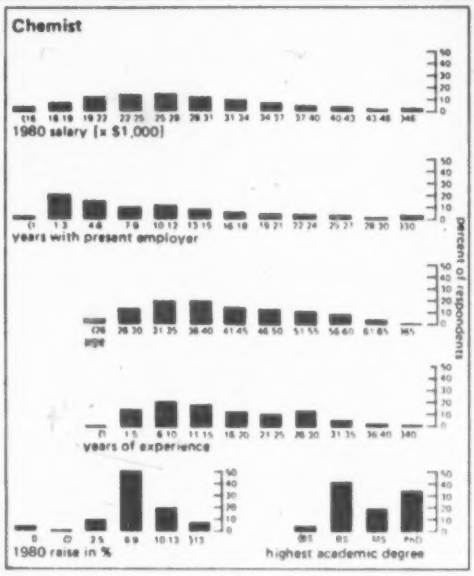
The dollar value of an advanced degree obviously varies by profession. For the R&D industry as a whole, median salaries by highest academic degree are:

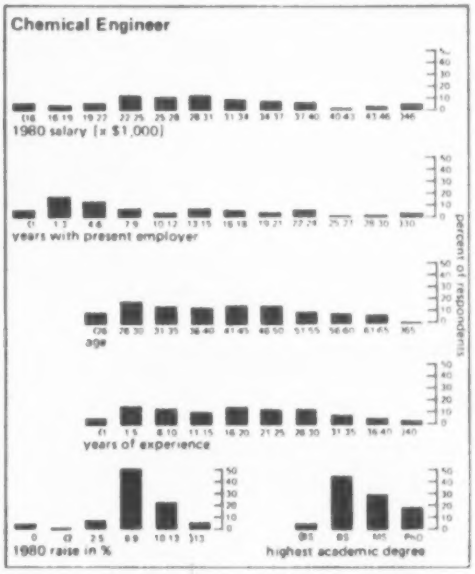
Degree	Median salary	Difference over next lower degree
Doctorate	$32,252	$3,876
Master's	28,376	2,067
Bachelor's	26,309	3,310
< Bachelor's	22,999	

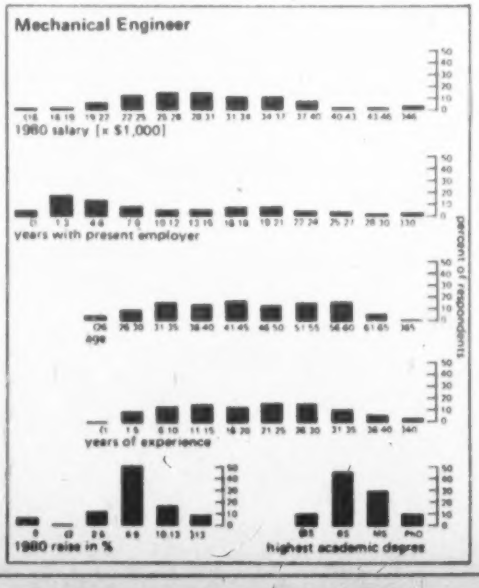
As you can see, the advantage for a PhD over less-than-bachelor's, based on these medians, is $9,253, and for PhD over bachelor's, is $5,943.

If we assume a 25-year career, not at all out of line according to reports from this year's respondents, charted elsewhere, and an interest rate of 7.5%, the advantage of the doctorate over the MS is in the neighborhood of $285,000. MS over BS could be worth more than $150,000 under the same conditions, and BS over less than BS would be worth more than $240,000.

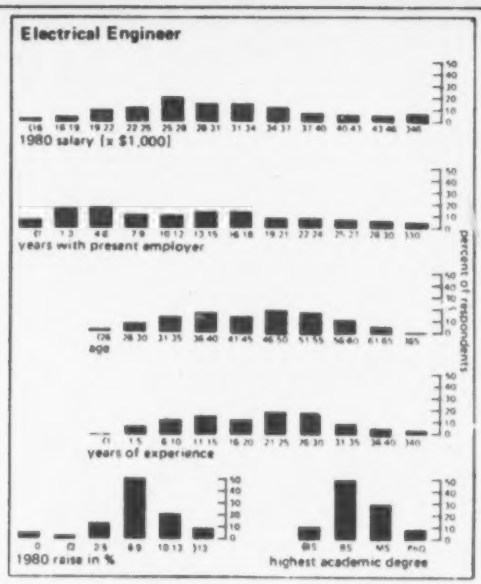
Taken as a direct benefit on the basis just

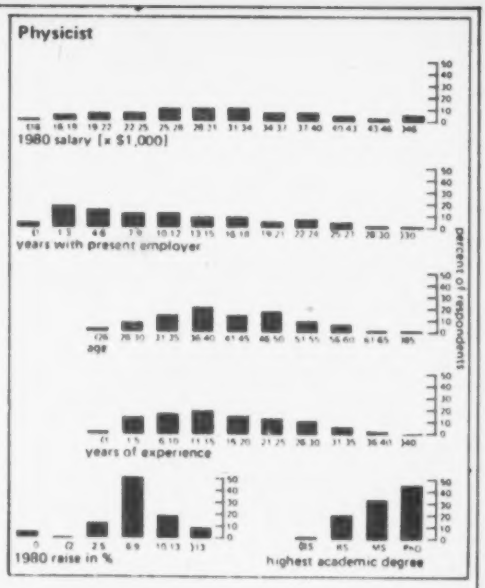


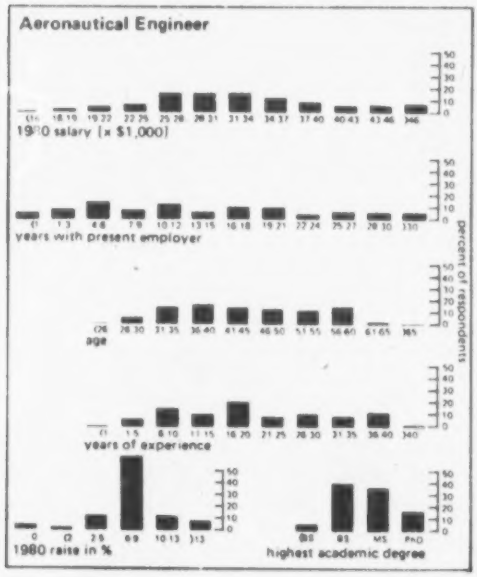


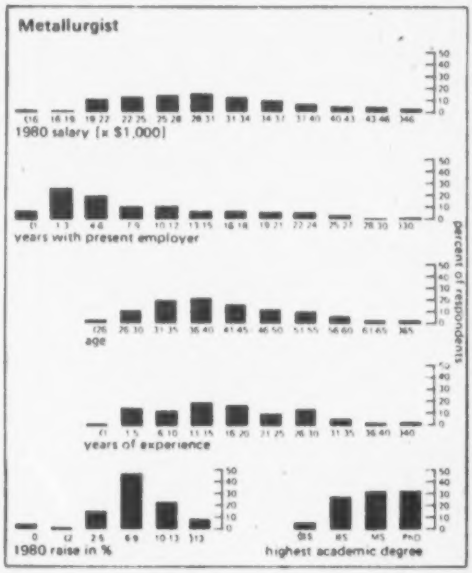


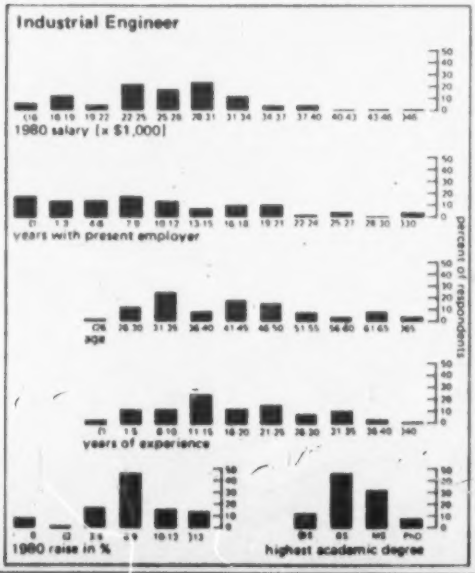
On these two pages and on page 108 you have an opportunity to compare the details of salary by ranges, years of experience, age, highest degrees held, years with present employer, and raise during the past year for each of the professional groups surveyed. The comparisons reveal some significant differences.

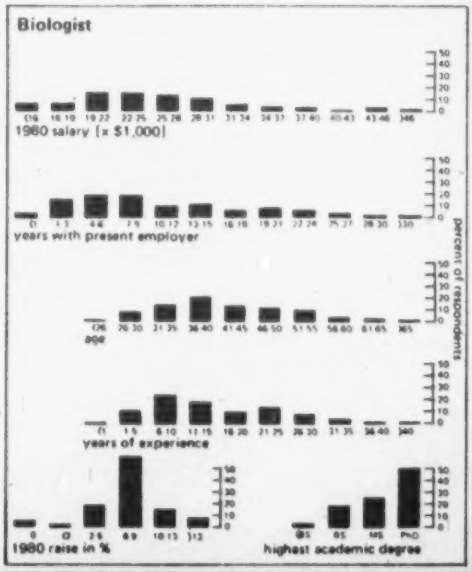

Electrical Engineer
1980 salary [x $1,000]
years with present employer
age
years of experience
1980 raise in %
highest academic degree
percent of respondents

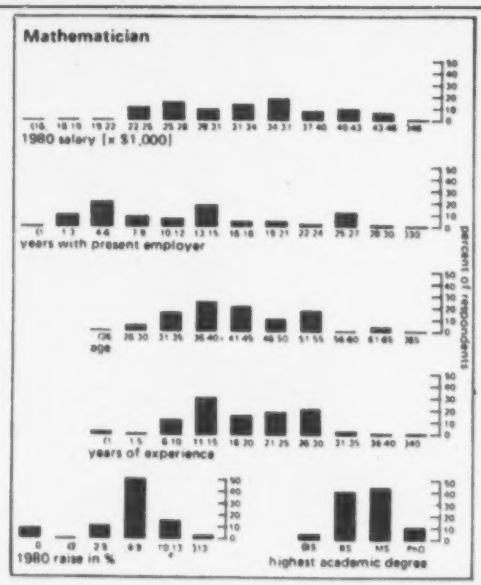

Physicist
1980 salary [x $1,000]
years with present employer
age
years of experience
1980 raise in %
highest academic degree
percent of respondents

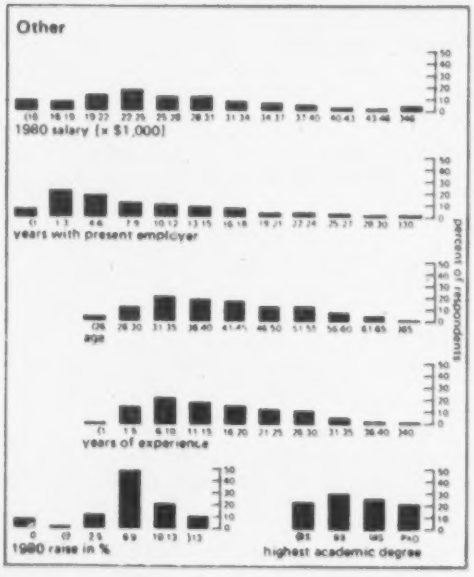

Aeronautical Engineer
1980 salary [x $1,000]
years with present employer
age
years of experience
1980 raise in %
highest academic degree
percent of respondents


Metallurgist
1980 salary [x $1,000]
years with present employer
age
years of experience
1980 raise in %
highest academic degree
percent of respondents


Industrial Engineer
1980 salary [x $1,000]
years with present employer
age
years of experience
1980 raise in %
highest academic degree
percent of respondents


Biologist
1980 salary [x $1,000]
years with present employer
age
years of experience
1980 raise in %
highest academic degree
percent of respondents





stated, the advantage in annual salary for a PhD when compared to a bachelor's, would provide a career gain of just under $440,000. Even allowing $165,000 for five additional income years for the person who starts working at the end of four years' college and to cover tuition for the PhD, the advantage to the latter still is in the neighborhood of $275,000.

The advantage of a doctorate has increased strikingly in recent years. In both 1976 and 1977, our respondents placed the annual advantage at approximately $2,200. In 1978 it dropped to $2,000. Last year we could report a benefit of $3,300, and as noted above, this year the advantage is $3,876 as an average for all R&D.

This fact is emphasized by looking at the breakdown by degrees in the upper salary ranges for all respondents:

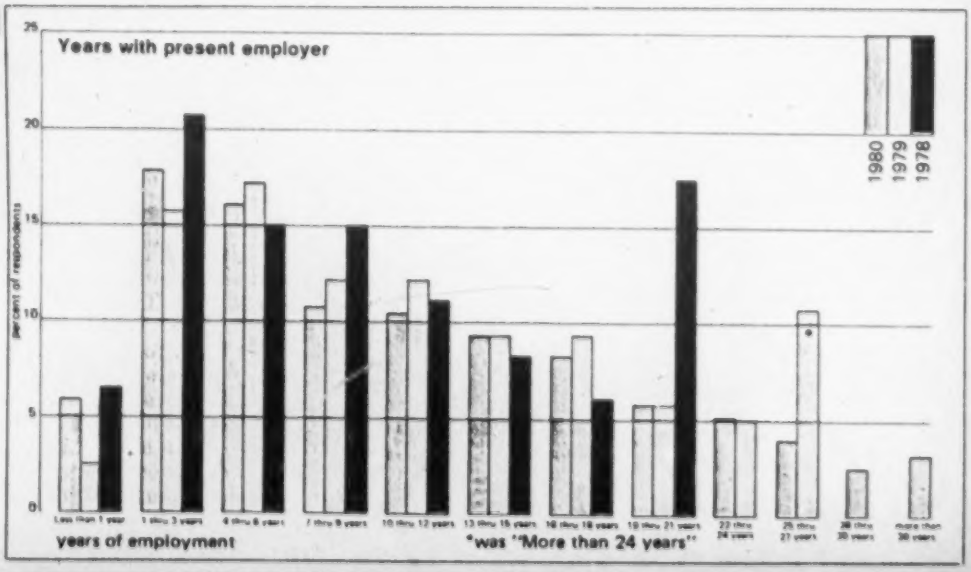
	Distribution of degrees			
Group	BS	BS	MS	PhD
All responding	7.9%	38.2%	25.7%	28.2%
$40,000 to $42,999	1.6	24.4	22.8	51.1
$43,000 to $45,999	2.1	28.9	23.9	45.1
More than $46,000	3.4	21.6	18.6	56.4

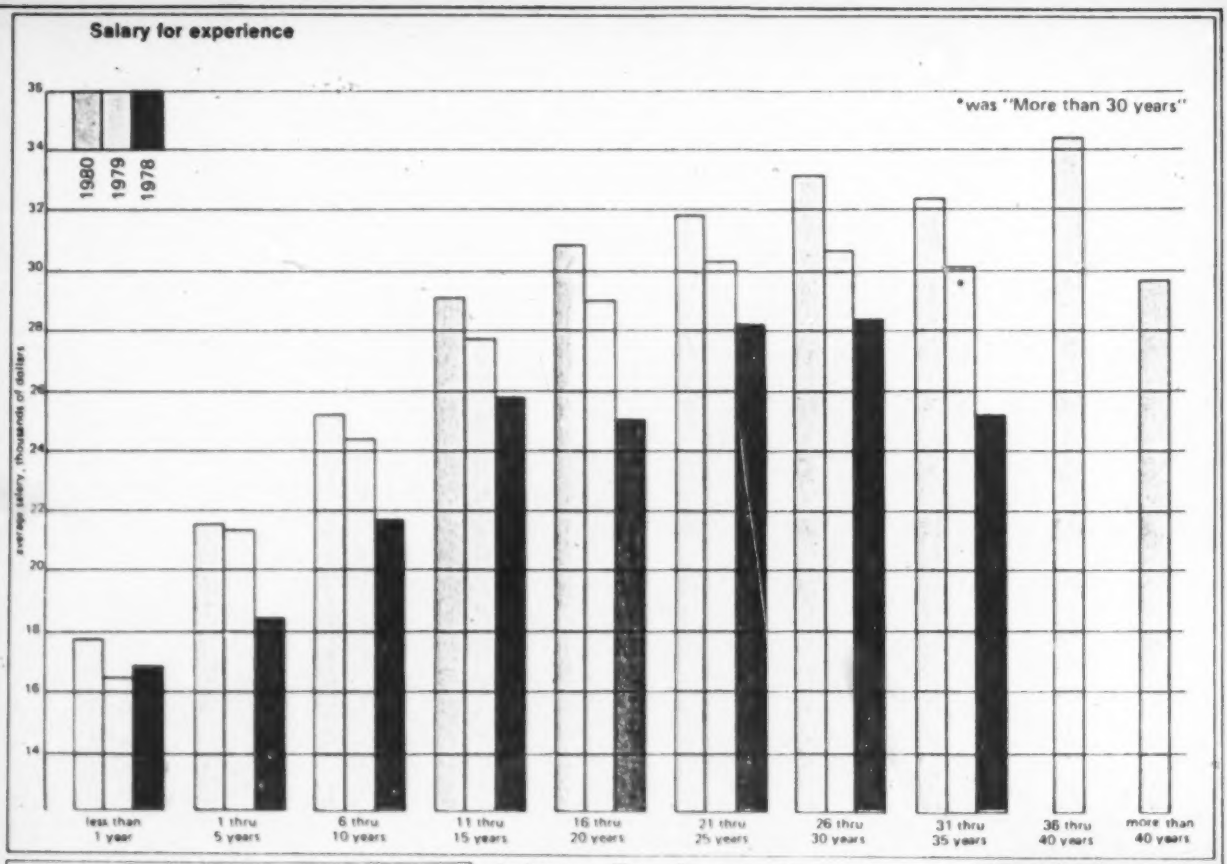
One could assume that if academic degree were not a factor in the above placings, distribution of degrees in all salary ranges would be the same as the distribution for the total respondents.

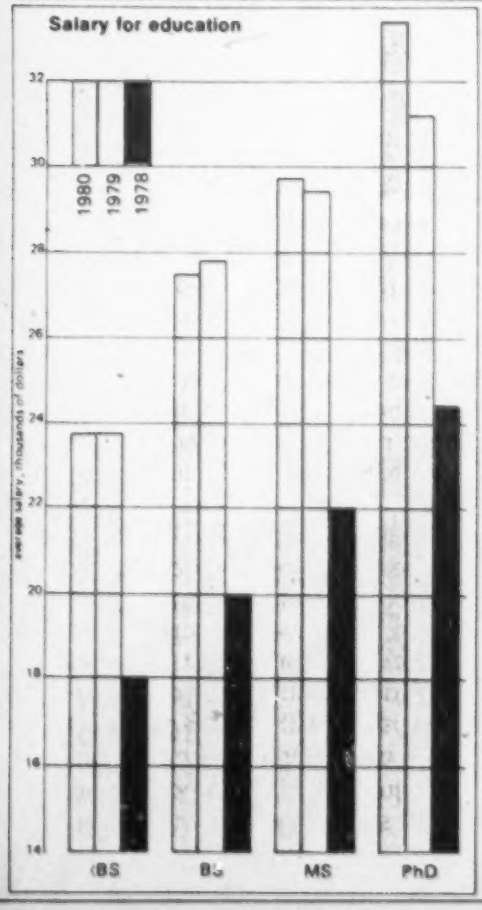
Looking at the question of age, one begins to wonder whether the field of physics is being replenished, whether the latest ideas are being brought into the ranks, and—possibly—whether there might be an indication here that physics would offer a great opportunity for a person now starting to college.

We say this because fewer than 10% of all physicists are younger than 31, if our respondents are representative of the R&D

In a nation known for mobility, U.S. R&D workers are surprisingly stable. As with our salary chart, we have had to add to the upper ranges in this chart showing the number of years with the present employer.







industry. For all respondents there are 14.1% in that younger-than-31 age group, and chemical engineers are an especially youthful group, with 23% being 30 or younger.

Across the board, 62% are between the ages of 30 and 51.

A possible indication of changed retirement policies may have showed up in this year's survey. Whereas last year, none of the professional categories had more than 1% in the older-than-65 age groups, this year three categories do.

Industrial engineers have the highest percentage over 65, at 3.5%, but with only 57 respondents, that means two people. It's hard to project such figures with great confidence. However, 4 of the 227 metallurgists and 9 of the 500 mechanical engineers are in that age group, for 1.8% in each case, and a closer approach to confidence in the figures.

Much additional information about the people who work in research, development, and quality assurance is provided in the charts which accompany this text.

In the second part of this salary report we will present the salary picture as provided by the same 5,000-plus respondents when broken into categories of sex and workplace.

When you read that second article you will see that other important changes are occurring in the R&D industry, and you will be able to read types of information which we have not been able to derive in previous years. □

Employers pay for experience and education. In the charts on this page we have tried to show the benefits separately. Benefits that accrue to a PhD are extrapolated over a 25-year career in the text.